

### **REMARKS**

In this Supplement to the Amendment of 7 July 2003 the entire original amendment is repeated for convenience, and the inadvertently omitted arguments are added begging at page of these remarks. In a telephone conversation the Examiner agreed that any requirement for corrected drawings would be held in abeyance until after consideration of the proposed drawing amendment included herein.

### **Specification**

In the Office Action the Examiner objected to informalities in the Specification and to lack of proper indications to Fig. 1a, 1b, etc. The amendments above are believed to have cured the lack of proper indications. As explained below of the difficulty is due to the figure indications and micrometer bar being printed in black in the original. Applicants intend to provide final drawings in which all such indications are printed in white so as to be readily discernible.

Applicants respectfully disagree with the Examiner's comments regarding "foot notes." The additional references are provided for the convenience of those reproducing or extending the Applicants' results. Since some of the references are cited more than one time, Applicants believe that incorporating the references directly into the text would significantly increase the length of the printed patent while, at the same time, significantly decrease the readability without providing any significant benefit. Applicants request that the Examiner and her Supervisor consider the advantages of using this approach to references. The environmental savings in paper alone should militate towards this approach. If, however, it is determined that the USPTO has a firm policy against this type of citation,

Applicants will, of course, submit the requested amendments with their reply to the next Office Action.

### **Drawings**

The Examiner objected to the apparent lack of proper labeling of the drawings. In the originally submitted drawings the panels were "1a", "1b", etc. In addition, the original drawings contained micrometer markers to allow judgment concerning dimensions of the structures. However, it appears that the photocopies provided to the Examiner did not show these markings. The problem appears to be that the markings in question are "black" and in the copies these marking were obscured. Appended hereto are reprinted drawings (low resolution) so that the Examiner can discern the markings. Applicants would like the Examiner's approval to use these marking but invert them into white characters against the darker photographs. Unfortunately, the artists have not yet produced the modified white markings. If the Examiner approves the concept, figures using white markings (that is "a". "b" and "micrometers" as white characters).

### **Claim Rejections under 35 U.S.C. § 112, second paragraph**

The Examiner rejected claims 13-16, 29-32 and 41-43 under 35 U.S.C. § 112, second paragraph. Applicants believe that the claim amendments made above have corrected these claim problems. Applicants respectfully request the rejections under 35 U.S.C. § 112, second paragraph.

### **Claim Rejections under 35 U.S.C. § 102**

The Examiner has rejected claims 1-3, 7, 8, 11, 12, 18-20, 24, 25, 28, 34, 37, and 40 under 35 U.S.C. § 102(b) as being anticipated by **Morgan et al.** (US Patent No. 5,665, 463). The Examiner's point is that this reference teaches a

ceramic composite with a bonded interface between the constituents of the ceramic composite (the bond material being chosen from monazites and xenotimes).

Applicants' invention is a thermal barrier. As explained in the Background section of the Specification, thermal barriers are relatively thick (more often 100-200  $\mu\text{m}$  or more depending on the thermal conductivity of the barrier material) exterior coatings of a material with a low thermal conductivity (see paragraph beginning at line 2 of page 2) intended to protect a coated substrate from heat damage. Thermal conductivity of usable barrier materials is in general less than about 2 W/mK which is similar to the conductivity of zirconia—a commonly used thermal barrier material (see page 9, line 15). The thermal conductivity and other critical characteristics can be favorably modified by altering the porosity and crystal structure of the coating. In theory, the thicker the coating, the better the thermal barrier. However, the thicker the coating, the more likely that the layer will be lost due to spalling. In addition, traditional barrier layer materials are prone to breakdown through corrosion, etc. The present invention uses monazites and xenotimes to create barrier layers that resist the usual causes of failure.

In terms of **Morgan et al.** Applicants point out that the reference teaches nothing concerning thermal barrier coatings. Rather it teaches a ceramic composite with xenotime or monazite interfaces between the constituents of the composite. Such a structure would not provide the thermal resistance of an effective thermal barrier coating. The present invention teaches how to make monazite or xenotime thermal barriers in which are relatively thick layers with the thermally non-conductive material throughout as opposed to the composites of **Morgan et al.** where the rare earth material is largely present at interfaces.

In terms of the Examiners comments regarding the 1:1 stoichiometric mature of the materials—for example, in reference to claim 3—Applicants agree that it is well known from the literature that these compounds had this characteristic. Therefore, in the case of the claim where the ratio is about 1:1 any excess of either the rare earth or the phosphorous must exist in a second phase.

In terms of the rejections under 35 U.S.C. §102(b) based on **Glassman et al.** (US Pat. No. 5,698,022) Applicants point out that this reference provides a method for making lanthanide/phosphorous *thin films* and interface coating for composites of the type disclosed by **Morgan et al.** A reading of the reference shows that the “substrate” that is coated is a filament or multifilament fiber tow used in making a composite. There is no teaching of a relatively thick unreinforced layer having sufficient thermal insulation properties. Prior to the present invention it was not known that layers having these properties could be formed from monazites and xenotimes.

In terms of the claim rejections made under 35 U.S.C. §102(b) based on **Hunt et al.** (US Pat. No. 5,858,465) Applicants point out that **Hunt et al.** disclose metal phosphate films containing essentially any type of metal. These films are either thin coatings used for corrosion resistance or interface films used with composites of the **Morgan et al.** type. As pointed out above composites are not the unreinforced layers with thermally non-conductive material throughout contemplated in the present thermal barrier invention. In addition, thin layers (generally less than 10  $\mu\text{m}$ ; see column 1 at line 34; column 10, line 27 et seq.) cannot have the thermal barrier properties required in the present invention. Further, while rare earth phosphates have the required thermal conductivity properties, **Hunt et al.** does not differentiate between rare earth and other phosphates (see paragraph starting at column 7, line 56). Thus this reference

teaches how to make thin films, some of which are of similar materials to the present invention, but none of which are non-composite thick films of the present invention.

In terms of the rejections based on **Tadokoro et al.** (US 6,200,672) this reference teaches a low temperature coating process for corrosion resistance, which include compositions containing rare-earth ions and many different functional groups including phosphoric groups (e.g., col. 5 lines 10-30). Coatings formed by this process consist of rare-earth metal complexes: they do not contain monazite or xenotime, which only form at significantly higher temperatures. Furthermore, **Tadokoro et al.** teaches that the corrosion resistance of the rare-earth metal complexes comes in part from the dissociation of the rare-earth metal element when corrosion proceeds (col. 6 lines 40 – 58). Since monazite and xenotime are extremely stable and would not dissociate under these conditions, this indicates that monazite and xenotime are not present and one would anticipate that they would not perform the described function. That is, the claims call for a layer of a particular phosphate having thermal protective properties. There is no indication that **Tadokoro et al.** discloses such a thermally protective layer of a phosphate. Rather the reference teaches a layer that is a matrix containing a phosphate as a component; such layer does not have the required compositional or structural requirements.

In terms of the rejections based on **Boakye et al.** (U.S. No. 5,759,632) this reference teaches particular methods for producing interface coatings in a composite. This is very similar to the interface structure described above in reference to **Morgan et al.** Essentially, both of these references disclose and teach the use of monazite interfaces to bond fibers to the matrix in a composite. This is neither structurally nor functionally equivalent to a thermal protective layer.

In terms of the rejections based on **Merrill et al.** (US No. 6,235,370) this reference teaches a coating consisting of ceramic spheres bonded together by a phosphate matrix. Although La and Y phosphates are included in the list of bonding materials in the background description, these are not known as good bonding agents. Physical measurements have in fact shown that rare-earth phosphates form intrinsically weak bonds with many materials. On the other hand, bonding with aluminum phosphate, as described in the actual example provided in **Merrill et al.** is well known (see also col. 5 lines 45 – 55). One of ordinary skill in the art would know that under the conditions described, monazite and xenotime would provide little or no bonding because the temperatures used are too low to allow sintering of these more refractory compounds (sintering would be necessary to form a dense material with intimate contact to the ceramic spheres). Therefore, assuming that the coatings described by **Merrill et al.** are formed and function as described they cannot contain monaxite or zenotime.

In terms of the rejections based on **Sojai et al.** (US No. 6,190,780) this reference teaches corrosion inhibiting layers similar to those of **Tadokoro et al.** The same argument made above in reference to **Tadokoro et al.** applies to **Sojai et al.** The layers described are not layers of rare-earth phosphate. Rather the layers are matrices that may even contain organic resins. The fact that pure layers are not contemplated is indicated, for example, at column 8, line 66, where it is indicated that for adequate corrosion resistance the amount of rare earth element can be as little as 1 mg per square meter. Such coating may well provide good corrosion resistance but they cannot function as thermal barriers or thermal protective layers.

The claims have been amended to clarify the characteristics of the present invention that distinguishes it from the cited art. Because none of the cited prior art now teaches each and every element of the present invention as claimed,

Applicants respectfully request the Examiner to withdraw the claim rejections made under 35 U.S.C. §102(b).

In view of the foregoing, it is respectfully submitted that the application is in condition for allowance. Reexamination and reconsideration of the application, as amended, are requested.

If for any reason the Examiner has any questions or still finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles telephone number listed below to discuss the steps necessary for placing the application in condition for allowance.

You are hereby authorized to charge any fees due and refund any surplus fees to our Deposit Account No. 50-2567.

Respectfully submitted,

REED SMITH CROSBY HEAFEY

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By:



Stefan U. Kirchanski

Registration No. 36,568

Attorney for Applicants

1901 Avenue of the Stars, Suite 700  
Los Angeles, CA 90067  
Telephone: (310) 734-5200  
Facsimile: (310) 734-5299